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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
CHANG, EDITH M	
ART UNIT	**PAPER NUMBER**
2611	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	**Application No.** 10/682,160	**Applicant(s)** KETCHUM ET AL.
	Examiner Edith M. Chang	**Art Unit** 2611

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *08 October 2003*.
2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.
3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-34* is/are pending in the application.
  4a) Of the above claim(s) _____ is/are withdrawn from consideration.
5)☐ Claim(s) _____ is/are allowed.
6)☒ Claim(s) *1-34* is/are rejected.
7)☐ Claim(s) _____ is/are objected to.
8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.
10)☒ The drawing(s) filed on *08 October 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.
  Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
  Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
  a)☐ All b)☐ Some * c)☐ None of:
    1.☐ Certified copies of the priority documents have been received.
    2.☐ Certified copies of the priority documents have been received in Application No. _____.
    3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
  * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *20050411*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Objections

1. Claims 1-14 and 19-25 are objected to because of the following informalities:

Claims 1 & 19, line 4: "in the system" should be "in the wireless MIMO communication system".

Claim 11, line 5: "in the system" should be "in the wireless MIMO communication system".

Claims 2-10, 12-14 and 20-25 are dependent on the objected claims 1, 11 and 19.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 4 and 7 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 4, line 2: the ^{H} of $(Wr\text{-}s)^H$ does not have legend to particularly point out and describe the ^{H} in the formula of the subject matter

Claim 7, line 3: the ^{H} of V^H and H^H do not have legend to particularly point out and describe the ^{H} in the formula of the subject matter.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. Claims 1-3, 5, 9-21, 25-26, 30 and 34 are rejected under 35 U.S.C. 102(e) as being anticipated by Zhuang et al. (US 2003/0123381 A1).

Regarding **claims 1, 11** & **15**, in FIG.8, Zhuang et al. discloses a receiver (a receiver apparatus) and its method of performing spatial processing in a wireless multiple-input multiple-output (MIMO) communication system ([0001]). The receiver comprises:

A *receiver unit* (or means, 81 & 82) obtaining a plurality of received symbol streams (outputs of 81 & 82, y_k of [0036]) for a plurality of data symbol streams (27) sent via a plurality of spatial channels of a MIMO channel (27 FIG.2, FIG.3 or FIG.4), wherein a transmitter (FIG.2) with steering vectors required to orthogonalizes the plurality of spatial channels (23 & 24 FIG.2) performs spatial processing ([0037]); and

A *spatial filter* (or means, 83 & [0046] MMSE Filtering) for spatially process the plurality of received symbol streams (y_k of [0036]) to obtain a plurality of filtered symbol streams (equation (9) of [0047]), which are estimates of the plurality of data symbol streams ([0048]), wherein the spatial filter has a response derived based on a minimum mean square error (MMSE, [0046]) between of the input of the filter (the plurality of data symbol streams 27) and output of the spatial filter (the plurality of filtered symbol streams).

Regarding **claims 2, 12** & **16,** inherit the limitations of claims 1, 11 and 15 respectively, further, Zhuang et al. discloses that scaling the normalized estimating of the filtering ([0050], lines 1-6 & lines 13-17).

Regarding **claim 3,** inherits the limitations of claim 1, and is the mathematical formula/expression of the filter; the mathematical formula is inherently provided and is not unique.

Regarding **claims 5, 13** & **17,** inherit the limitations of claims 1, 11 and 15 respectively, further, Zhuang et al. discloses obtaining an estimate of channel response matrix ([0037]); and deriving the filter response based on the estimated channel response matrix ([0047]).

Regarding **claims 9** & **21,** inherit the limitations of claims 1 and 19 respectively, further, Zhuang et al. discloses decomposing an estimate of a channel response matrix to spatially process the plurality of data symbol streams (FIG.1, [0037] wherein the H_k channel matrix is decomposed at subcarrier)

Regarding **claims 10, 14, 18, 25** & **34**, inherit the limitations of claim 1, 11, 15, 19 and 30 respectively, further, Zhuang et al. discloses the MIMO system implementing orthogonal frequency division multiplexing (OFDM) (23 & 24 FIG.2, [0002]), wherein for each of a plurality of subbands is performed.

Regarding **claim 20,** inherits the limitations of claim 19, and is the mathematical formula/expression of the orthogonalized spatial channels; the mathematical formula is inherently provided by the spatial processing and is not unique.

Regarding **claims 19, 26** & **30**, in FIG.2, Zhuang et al. discloses a transmitter (a transmitter apparatus) and its method of performing spatial processing in a wireless multiple-input multiple-output (MIMO) communication system ([0001]). The transmitter comprises:

A transmit data processor (21 FIG.2) to process a plurality of data streams (SOURCE 1 & SOURCE 2) and provide a plurality of data symbol streams ([0016], lines 1-10) for transmission on a plurality of spatial channels of a MIMO channel (27 FIG.2); and

A transmit spatial processor (22 FIG.2, [0016] lines 10-21) to perform spatial processing with vectors required ortogonalize (23 & 24 FIG.2) the plurality of spatial channels (27 FIG.2); and

wherein the plurality of data symbol streams are recovered at a receiver with a MMSE filtering ([0046]).

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claims 6, 8, 22-24, 27-29 and 31-33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhuang et al. (US 2003/0123381 A1) in view of Ketchum et al. (US 2004/0179627 A1).

Regarding **claims 6, 8,** and **24**, inherit the limitations of claims 1, 19 and 30 respectively, although Zhuang et al. does not explicitly specify the steered pilot (or pilot), however, Ketchum et al. teaches the steered pilot (or pilot [012] & FIG.3) transmitted from all transmit antennas and may be used for channel estimation.

As Zhuang et al.'s invention relates to wireless transmission and reception, which comprise pilot transmission and reception, using MIMO modulation ([0001]), at the time of the invention was made, it would have been obvious to one of ordinary skill in the art to have the steered pilot taught by Ketchum et al. transmitted by all transmit antennas for timing and frequency acquisition, channel estimation, calibration, and so on ([0011]) for proper system operation.

Regarding **claims 22, 23, 27-29** and **31-33**, inherit the limitations of claims 19, 26 and 30 respectively, although Zhuang et al. does not explicitly specify the plurality of data symbol streams transmitted on a first link (forward channel) and the plurality of steering vectors derived based on an estimate of a second link (reverse channel), however, Ketchum et al. teaches transmitting pilots on the downlink (the first link) 312 FIG.3 & [0009] ('627), and wherein the plurality of steering vectors are derived based on an estimate of uplink (the second link) 334 FIG.3 & [0012] ('627).

As Zhuang et al.'s invention relates to wireless transmission and reception, which is either time division or frequency division system, using MIMO modulation ([0001]), at the time of the invention was made, it would have been obvious to one of ordinary skill in the art to have the plurality of data symbol streams transmitted on the first link, receiving a steered pilot via the second link and deriving the steering vectors used for the first link; decomposing the estimate channel response matrix (334 FIG.3) for the second link as recited in the claims for timing and frequency acquisition, channel estimation, calibration, and so on ([0011]) for proper system operation.

Allowable Subject Matter

8. Claims 4 and 7 would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112, 2nd paragraph, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter:

The prior art of record fails to teach or suggest, alone or in a combination, among other things, at least a method of performing spatial processing at a receiver in a wireless multiple-input multiple-output (MIMO) communication system as a whole, the combination of elements and features, which includes the minimum mean square error (MMSE) criterion given as min $E[(Wr-s)^H (Wr-s)]$ or the spatial filter response is derived in accordance with the formula recited in the claims.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Edith M. Chang whose telephone number is 571-272-3041. The examiner can normally be reached on M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mohammed H. Ghayour can be reached on 571-272-3021. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Edith Chang
May 10, 2006

KHAI TRAN
PRIMARY EXAMINER